WHAT IS CLAIMED IS:

~~1. A fiber reinforced composite article comprising a matrix and reinforcing fibers, the article during operation experiencing concurrently in the article a plurality of operating temperatures and stresses, varying between a plurality of regions of the article;~~

~~a first region of the article during operation experiencing a first temperature and a first stress, and including first fibers having a first strength greater than the first stress; and,~~

~~a second region of the article during operation experiencing a second temperature less than the first temperature and a second stress greater than the first stress, and including second fibers having a second strength greater than the second stress.~~

2. The article of claim 1 in which:

the first fibers have a first coefficient of thermal expansion (CTE) at the first temperature; and,

the second fibers have a second CTE at the second temperature greater than the first CTE at the first temperature.

3. The article of claim 2 in which the second strength of the second region is greater than the difference between the first stress and the second stress as determined by the relationship:

$A_1E_1\alpha_1T_1 - A_2E_2\alpha_2T_2 < S_2$, in which, respectively for the first region (1) and the second region (2):

A is the area ratio of a region area to a total area of the regions,

E is the elastic modulus of the fiber reinforced matrix,

α is the CTE of the fiber reinforced matrix at the operating temperature in °F,

T is the operating temperature in °F, and

S is the strength of the second region.

4. The article of claim 3 in which the first and second fibers are in at least one form selected from the group consisting of fabric, weave, braid, and lay-up.

5. The article of claim 3 in which:

the first temperature is in the range of about 1600 - 2000° F; and,

the second temperature is in the range of about 900 - 1300° F.

6. The article of claim 5 in which the matrix is ceramic based on alumina.

7. The article of claim 5 in which the fibers are included in the range of about 20 – 70 volume %.

8. The article of claim 6 in which the first and second fibers are based on alumina.

9. The article of claim 6 in which the matrix includes silica.

10. The article of claim 5 in the form of a turbine engine article in which:

the matrix is a ceramic; and,

the first fibers and the second fibers are high temperature fibers made from at least one material selected from the group consisting of alumina, silica, glass, graphite, carbon, carbides, tungsten, boron, and their mixtures.

11. The article of claim 9 in the form of a gas turbine engine exhaust flap in which the fibers are included in each region in the range of about 20 – 70 volume %.

12. The article of claim 4 in the form of a gas turbine engine blading component in which the fibers are included in each region in the range of about 20 – 70 volume %.

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13. A member, ~~for making the fiber reinforced composite article of claim 1~~, comprising reinforcing fibers for reinforcement of a fiber reinforced composite article, the member during operation experiencing concurrently in the member a plurality of operating temperatures and stresses, varying between a plurality of regions of the member;

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~~a first region of the member during operation experiencing a first temperature and a first stress, and including first fibers having a first strength greater than the first stress; and,~~

~~a second region of the member during operation experiencing a second temperature less than the first temperature and a second stress greater than the first stress, and including second fibers having a second strength greater than the second stress.~~

14. The member of claim 13 in which:

the first fibers have a first coefficient of thermal expansion (CTE) at the first temperature; and,

the second fibers have a second CTE at the second temperature greater than the first CTE at the first temperature.

15. The member of claim 14 in which the second strength of the second region of the article is greater than the difference between the first stress and the second stress as determined by the relationship:

$A_1E_1\alpha_1T_1 - A_2E_2\alpha_2T_2 < S_2$, in which, respectively for the first region (1) and the second region (2):

A is the area ratio of a region area to a total area of the regions,

E is the elastic modulus of the fiber reinforced matrix,

α is the CTE of the fiber reinforced matrix at the operating temperature in °F,

T is the operating temperature in °F, and

S is the strength of the second region.

16. The member of claim 14 in at least one form selected from the group consisting of fabric, weave, braid, and lay-up.

17. The member of claim 15 in which:

the first temperature is in the range of about 1600 - 2000° F; and,

the second temperature is in the range of about 900 - 1300° F.

18. The member of claim 17 in which the first and second fibers are based on alumina.

19. In a method for making ~~the~~ a fiber reinforced matrix composite article ~~of claim 1,~~ comprising the steps of:

selecting the first fibers to have the first strength greater than the first stress;

selecting the second fibers to have the second strength greater than the second stress;

disposing the first fibers as reinforcing fibers in the matrix in the first region of the article; and,

disposing the second fibers as reinforcing fibers in the matrix in the second region of the article.

20. The method of claim 19 in which:

the first fibers have a first coefficient of thermal expansion (CTE) at the first temperature; and,

the second fibers have a second CTE at the second temperature greater than the first CTE at the first temperature.

21. The method of claim 20 in which the second strength of the second region is greater than the difference between the first stress and the second stress and is determined by the relationship:

$A_1E_1\alpha_1T_1 - A_2E_2\alpha_2T_2 < S_2$, in which, respectively for the first region (1) and the second region (2):

A is the area ratio of a region area to a total area of the region,

E is the elastic modulus of the fiber reinforced matrix,

α is the CTE of the fiber reinforced matrix at the operating temperature in °F,

T is the operating temperature in °F, and

S is the strength of the second region.

22. The method of claim 20 in which the first and second fibers are provided in at least one form selected from the group consisting of fabric, weave, braid, and lay-up for disposing in the first and second regions.

23. The method of claim 22 in which the first fibers and the second fibers are high temperature fibers are made from at least one material selected from the group consisting of alumina, silica, glass, graphite, carbon, carbides, tungsten boron and their mixtures.

24. The method of claim 22 for making a turbine engine fiber reinforced composite article in which:

the matrix of the composite article is based on alumina; and,

the first fibers and the second fibers are disposed in the matrix in the range of about 20 – 70 volume %.

25. The method of claim 24 in which:

the composite article is a gas turbine engine exhaust flap;

the first temperature is in the range of about 1600 - 2000° F;

the second temperature is in the range of about 900 - 1300° F; and,

the first and second fibers are based on alumina.

26. The method of claim 21 in which:

the composite article is a gas turbine engine blading component; and,

the first fibers and the second fibers are disposed in the matrix in the range of about 20 – 70 volume %.

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27. In a method for making ~~the~~ a member comprising ~~of claim 13;~~ the steps of:

selecting the first fibers to have the first strength greater than the first stress;

selecting the second fibers to have the second strength greater than the second stress;

disposing the first fibers as reinforcing fibers in the matrix in the first region of the member; and,

disposing the second fibers as reinforcing fibers in the matrix in the second region of the member.

28. The method of claim 27 in which:

the first fibers have a first coefficient of thermal expansion (CTE) at the first temperature; and,

the second fibers have a second CTE at the second temperature greater than the first CTE at the first temperature.

29. The method of claim 28 in which the second strength of the second region is greater than the difference between the first stress and the second stress and is determined by the relationship:

$A_1E_1\alpha_1T_1 - A_2E_2\alpha_2T_2 < S_2$, in which, respectively for the first region (1) and the second region (2):

A is the area ratio of a region area to a total area of the regions,

E is the elastic modulus of the fiber reinforced matrix,

α is the CTE of the fiber reinforced matrix at the operating temperature in °F,

T is the operating temperature in °F, and

S is the strength of the second region.

30. The method of claim 28 in which the first and second fibers are provided in at least one form selected from the group consisting of fabric, weave, braid, and lay-up for disposing in the first and second regions.

31. The method of claim 30 in which the first fibers and the second fibers are high temperature fibers are made from at least one material selected from the group consisting of alumina, silica, glass, graphite, carbon, carbides, tungsten boron and their mixtures.

32. The method of claim 28 for making a member for use as fiber reinforcement in a turbine engine fiber reinforced alumina-based matrix composite article in which:

the first temperature is in the range of about 1600 - 2000° F;

the second temperature is in the range of about 900 - 1300° F; and,

the first fibers and the second fibers are disposed in the matrix in the range of about 20 – 70 volume %.

33. The method of claim 32 in which:
the composite article is a gas turbine engine exhaust flap; and,
the first and second fibers are based on alumina.

34. The method of claim 28 for making a member for use as a fiber reinforcement in a fiber reinforced gas turbine engine blading component in which the first fibers and the second fibers are disposed in the matrix in the range of about 20 – 70 volume %.

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